

A Dose of Defense?

Omega-3 Supplements Appear Protective against PM Effects

Omega-3 polyunsaturated fatty acids, believed to lessen the risk of many chronic ailments including arthritis, cancer, heart disease, and memory loss, may also help protect the heart against certain damaging effects of air pollution. In a new study by an international team of researchers, supplementation with omega-3s was associated with significantly reduced cardiac stress caused by particulate matter less than 2.5 μm in diameter ($\text{PM}_{2.5}$) in a group of elderly individuals in Mexico City [EHP 116:1237–1242; Romieu et al.]. The study is the first to examine the effects of omega-3s on biomarkers of cellular response to the oxidative stress of air pollution.

Exposure to high levels of particulates from vehicle exhaust and industrial emissions raises the risk of hypertension, heart arrhythmia, heart attack, and stroke, with the elderly being particularly susceptible. Some of the authors had previously shown both that $\text{PM}_{2.5}$ promotes heart disease by diminishing heart-rate variability and that omega-3 supplementation could increase heart-rate variability. The current study was intended to find out how omega-3s achieve their effects.

The study population of 52 elderly nursing home residents was chronically exposed to high $\text{PM}_{2.5}$ levels; particulate levels inside the nursing home, where residents spent nearly all their time, correlated with the smoggy surroundings outside. For four months starting in 2001, half the participants in the double-blind study received fish oil supplements at doses typical for over-the-counter supplement users; the other half received soy oil supplements.

The research team compared blood samples taken from subjects before and during supplementation and found that omega-3 use was associated with diminished oxidative damage in blood cells. The observed antioxidant effect of omega-3s was much greater in fish oil users than in soy oil users, a difference the investigators attribute to the different amounts and types of omega-3s in the two supplement types (docosahexaenoic acid and eicosapentaenoic acid in fish oil versus α -linolenic acid in soy oil).

The authors note limitations of their study, such as the small sample size and limited exposure assessment. However, the finding that omega-3s appear effective against oxidative stress related to $\text{PM}_{2.5}$ exposure, with fish oil supplements offering more protection than soy oil supplements, merits further study in larger populations. —Cynthia Washam

The CoolFactor

Season Modifies Cardiorespiratory Deaths in China

Outdoor air pollution has been linked with increased risk of death from cardiorespiratory disease in epidemiologic studies in North America and Europe. Some studies have found that sex, age, or other modifying factors can cause increased susceptibility to air pollution in some individuals. However, few of these studies have been conducted in Asia. Now a new study of Shanghai residents reveals that the elderly, women, and individuals with lower educational backgrounds are especially vulnerable to outdoor air pollution during cooler weather [EHP 116:1183–1188; Kan et al.].

The researchers examined death certificates recorded between 1 January 2001 and 31 December 2004 in the central area of Shanghai and found an average of 119 nonaccidental deaths reported daily, with 49.1% due to cardiorespiratory disease. They collected daily air pollution data for particulate matter less than 10 μm in diameter (PM_{10}), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and ozone (O_3) from the Chinese government agency that tracks air pollutants and assessed how mortality and pollutant levels varied by sex, age, educational status, and season of the year.

They found that most air pollutant levels peaked in the cool season (October through

March, when the temperature averages 58°F), correlating with a peak in the death rate; the exception was O_3 , which had higher concentrations in the warm season (April through September, when the temperature averages 75°F). They observed a 2- to 3-times greater risk of death from cardiorespiratory disease in the cool season compared with the warm season, with SO_2 , NO_2 , and O_3 particularly showing seasonal differences in association with cause of death. The same air pollutants were also associated with a 3- to 4-fold greater risk of cardiovascular death in the cool season than in the warm season, possibly because exposure to air pollutants is reduced by staying inside air-conditioned buildings.

Additionally, people older than 65 were up to 5 times more likely than younger people to die of cardiorespiratory disease. Compared with men, deaths in women were twice as likely to be linked to elevated O_3 and PM_{10} levels. This may be due to

men's greater rate of smoking, the effects of which may override pollution-related effects in male smokers. Overall, people with less education were twice as likely as more educated residents to die during periods of elevated pollution. Educational level, a reflection of socioeconomic status, has been reported previously as a modifying factor for air pollution-related deaths in North America and Europe, but this is the first such report from mainland China, where the concentrations of PM_{10} , SO_2 , and NO_2 are much higher. —Carol Potera



A study of Shanghai residents showed that cardiorespiratory deaths increased during the cool season, which runs from October through March.

Disaster Response

Mental Health Effects among WTC Rescue and Recovery Workers

The attacks on the World Trade Center (WTC) on 11 September 2001 exposed thousands of emergency responders and other recovery workers to a unique mix not only of airborne toxic pollutants but also psychological stressors. The physical consequences such as persistent respiratory ailments have been documented previously [e.g., *EHP* 114:1853–1858 (2006)]. The latest report from a 5-year study of health effects among WTC rescue and recovery workers describes a higher level of lingering mental health problems among these workers than in the general population [*EHP* 116:1248–1253; Stellman et al.].

More than 10,000 WTC workers completed several standard mental health questionnaires 10–61 months after the attacks. About 90% of the respondents worked at the WTC site during the first 2 weeks after 9/11, and the majority remained onsite for 3 months or longer. On the basis of an analysis of their responses, and in the absence of a clinical evaluation, the researchers classified 11.1% of workers with probable post-traumatic stress disorder (PTSD), 8.8% with probable depression, 5.0% with probable panic disorder, and 62% with substantial stress reactions (such as nightmares, flashbacks, and insomnia). Overall, mental health problems declined gradually from 13.5% to 9.7% among WTC workers during the course of the study.

The incidence of PTSD in WTC workers, which parallels that reported in soldiers returning from combat duty in Afghanistan, was about 4 times higher than that for the general population in the United States. Probable PTSD was associated with having lost family members or friends in the attacks; those with probable PTSD had a 17-fold greater likelihood of reporting disruption of family, work, and social life. About half those with probable PTSD also experienced probable panic disorder, depression, or both. Workers with probable PTSD also perceived their children as

having more psychological symptoms (such as clinginess or trouble sleeping) and behavioral problems than workers without PTSD.

Alcohol-related problems also were abundant in the study group. More than 17% reported symptoms of probable alcohol abuse. Nearly half reported drinking more heavily than usual during the period they worked at rescue and recovery efforts, and months later a third were still drinking more than usual.

The authors conclude that the variety of persistent mental health problems in responders “underscores the need for long-term mental health screening and treatment programs targeting this population.” Following future environmental disasters, they write, mental health problems are virtually certain to accompany physical effects of toxic exposures. Rescue and recovery workers therefore should receive behavioral health evaluations as well as medical evaluations to reduce adverse health and social consequences. —Carol Potera



A worker surveys the WTC site, 25 September 2001

“Metal Detector” Gene May Influence Lead Absorption

Variants Predict Higher Blood Lead Levels in Children

An estimated 310,000 U.S. children between ages 1 and 5 have elevated blood lead levels despite efforts to reduce lead in the environment. Research in the past decade has begun to focus on factors that could make some children more susceptible to lead poisoning even at low levels of exposure. A new study explores one such possible factor—gene variants that influence lead absorption—linking variants in two iron metabolism genes to higher blood lead levels in children [*EHP* 116:1261–1266; Hopkins et al.].

When researchers analyzed umbilical cord blood from 422 children in Mexico, they found that the presence of two variants of the hemochromatosis (*HFE*) gene—*HFE* C282Y and *HFE* H63D—predicted blood lead levels 11% higher than those in children not carrying the variants. Moreover, the presence of either *HFE* variant combined with a variant form of the transferrin (*TF*) receptor gene—*TF*-P570S—predicted blood lead levels 50% higher than in children with none of the variants.

Although the *HFE* and *TF* genes normally regulate iron metabolism, they may also influence blood lead levels because lead—like iron—is a divalent metal. Thus, the two metals can be “mistaken”

for each other during metabolic processes. The *HFE* gene regulates iron-binding proteins, including *TF*, and variant forms of this gene sometimes induce hemochromatosis, a disease characterized by increased intestinal absorption of iron that contributes to abnormally high iron stores in adulthood.

The authors hypothesized that the *HFE* variants might similarly increase absorption of lead, a hypothesis supported by the results of this study. *TF* interacts with *HFE* to form a complex that down-regulates iron absorption. However, *TF*-P570S may interact with the *HFE* variants in ways that heighten metal absorption rates. Study results showed the *TF* and *HFE* variants produced higher lead levels than those predicted by either *HFE* variant alone.

Previously published research by these investigators has shown that having the *HFE* variants predicted lower blood lead levels in elderly men compared with men without the variants. The contrasting findings, the authors speculate, may reflect age-specific differences in body iron stores and in the variants’ effect on lead metabolism. Among children with low iron body stores and high iron needs, the variants predicted higher blood lead levels. But as iron stores accumulate with age, the variants down-regulated iron and lead absorption, leading to progressive declines in blood lead levels. The study’s key implications are twofold: first, that children with variant iron-metabolizing genes may be especially susceptible to the effects of lead at low exposure levels, and second, that genetic variants may increase risk at one life stage and decrease it at others. —Charles W. Schmidt